6-K HELIUM ADSORPTION CRYOCOOLER

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The Jet Propulsion Laboratory is developing a low power, vibration-free 6-K to 18-K Joule-Thomson (J-T) continuous refrigeration stage, to support the refrigeration needs of a series of future space missions such as TPF, Con-X, and NGST. This refrigeration stage uses charcoal sorption to pump helium gas through a Joule-Thomson cycle. A major advantage of this charcoal cooler, besides eliminating the need for a room temperature compressor and piping, is the absence of check valves or other cold valves in the system. The circuit can be easily integrated with either sorption or mechanical pre-coolers able to produce a temperature lower than ~20 K and supply a cooling power on the order of 1.5 W at this temperature. Any improvement in pre-cooling temperature or cooling power available on precooling stage increases the performance of the 6 K stage. The mass and input power of these refrigeration stages scale approximately linearly with the required cooling power. This paper discusses the early experimental results of a J-T circuit design using cyclical flow between charcoal compressors through a single throttle. By alternating flow through the J-T throttle, we were able to cool the system to 5.5 K. We will describe the refrigeration capacity and temperature stability of this early cooler design, and discuss cooler design modifications to increase both the 6-K refrigeration capacity and the temperature stability.

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